

REMARKS***Summary of the Amendment***

Upon consideration of Applicants' present remarks, claims 14 - 37 will currently remain pending.

Summary of the Official Action

In the instant Office Action, the Examiner has rejected claims 14 - 37 over the art of record. By the present remarks, Applicants submit that the rejections have been overcome, and respectfully request reconsideration of the outstanding Office Action and allowance of the present application.

Request for Acknowledgment of Receipt of Certified Copy of Priority Document

Applicants request that the Examiner acknowledge receipt of the certified copy of the German priority document from the International Bureau. In this regard, Applicants note that the December 8, 1999 Notification of Missing Requirements Under 35 U.S.C. § 371 in the United States Designated/Elected Office (DO/EO/US) confirms receipt of the priority document, and Applicants request that the Examiner formally acknowledge the same to ensure that Applicants' claim of priority is in order.

Traversal of Rejection Under 35 U.S.C. § 103(a)

1. ***Over Adams in view of Niklason and further in view of Annis***

Applicants traverse the rejection of claims 14 - 24, and 27 - 37 under 35 U.S.C. § 103(a) as being unpatentable over ADAMS et al. (U.S. Patent No. 5,561,696) [hereinafter

“ADAMS”] in view of NIKLASON et al. (U.S. Patent No. 5,872,828) [hereinafter “NIKLASON”] and further in view of ANNIS (U.S. Patent No. 6,347,132). The Examiner asserts that ADAMS shows an apparatus for inspecting a test object with a movably arranged X-ray beam tube and detector 30 and a stationary object 10, and that the X-ray beam tube and the detector both have a small field of view in relation to the horizontal extent of the are of the test object to be inspected. While acknowledging that ADAMS fails to disclose a linearly moving beam tube and detector, the Examiner asserts that it would have been obvious to modify ADAMS in such a manner in view of the disclosure of NIKLASON. The Examiner also acknowledges that neither ADAMS nor NIKLASON teach or suggest a fixed test object, but that it would have been obvious to do so in view of ANNIS. Applicants traverse the Examiner’s assertions.

Applicants initially note that the U.S. filing date of the instant application, which is a U.S. National Stage of International Application No. PCT/DE97/02024, is September 9, 1997, and that the provisional application date of ANNIS, for which it can be prior art under 35 U.S.C. § 102(e), is May 26, 1998. Thus, as the U.S. filing date of the instant application antedates the provisional date of ANNIS, Applicants submit that ANNIS is not prior art against the instant application.

Because ANNIS is not prior art against the instant invention, Applicants submit that the asserted combination of documents is defective and, therefore, cannot render the instant

invention unpatentable under 35 U.S.C. § 103(a). Accordingly, Applicants submit that the instant rejection should be withdrawn.

Moreover, Applicants submit that, even assuming, *arguendo*, that ANNIS were prior art against the instant invention (which Applicants submit it clearly is not), Applicants submit that no proper combination of these documents can render Applicants' invention obvious.

While Applicants will not address the subject matter of ANNIS, since this subject matter is not prior art, Applicants note that the art of record fails to provide the necessary motivation or rationale for combining ADAMS and NIKLASON in the manner asserted by the Examiner, and that no proper combination of these documents can render Applicants' invention obvious.

Applicants again note that the present invention prevents much of the unintended damage to soldering joints that occurred in previously known inspection devices, in which the X-ray beam source and detector were fixedly mounted within an inspection chamber and the test piece was movably mounted within the inspection chamber. With this arrangement, it was necessary to move the test piece, and in particular, the various soldering joints of the test piece within the X-ray beam. However, Applicants found that the jostling/jarring of the test piece during the stopping and starting of the movement within the inspection chamber was loosening and/or breaking the soldering joints, and, that, if such joints were loosened and/or broken after inspection, the defects were not detected, and a defective test piece was

unwittingly deemed acceptable.

To address this deficiency of the prior art, the present invention is directed to a device and process in which the test piece is fixedly mounted in a stationary position throughout the inspection process, whereby the inadvertent loosening and/or breaking of soldering joints is substantially eliminated. However, because the test piece is fixedly mounted, the X-ray beam source and detector are mounted for linear movement in order to inspect each soldering joint located on the test piece. As discussed in the specification between page 5, line 14 and page 6, line 4, while movement of the X-ray beam source and detector is generally considered problematic, the present invention addresses and solves such problems by using an X-ray beam tube without a vacuum pump or cooling and a device for horizontally moving the X-ray beam tube and detector to ensure that these components are moved with great accuracy and at high speeds despite their large mass.

Accordingly, Applicants independent claim 14 recites, *inter alia*, the at least one test object is *fixed in a stationary position throughout the inspection*, and said X-ray beam tube and said detector are *linearly moveably arranged* within parallel X-Y planes for inspecting an entire area of the at least one test object. Further, Applicants independent claim 32 recites, *inter alia*, *fixedly mounting* the at least one test object *in a stationary position throughout the inspecting of an entire area* of the at least one object, and *linearly moving* the X-ray beam tube and the detector within parallel X-Y planes, thereby inspecting the entire

area of the at least one test object. Applicants submit that no proper combination of ADAMS and NIKLASON teaches or suggests at least the above-noted features.

Applicants note that, while not providing any specific disclosure as to how the source/detector arrangement is achieved, Figure 1 of ADAMS illustrates a source and a detector rotating about a common axis in parallel planes while inspecting a test piece. In this arrangement, while the beam is rotated about axis 40, the beam is focussed on a single point on the test piece. In a further embodiment, Figure 46a of ADAMS illustrates a stationary source mounted for rotation, but, like Figure 1, the produced beam is focussed on a single point on the test piece.

Thus, while ADAMS shows some movement of the source, ADAMS express discloses that the beam produced by the source should be focussed on a single point on the test piece, which is supported by a fixture attached to a positioning table for moving the test piece in the X, Y, and Z directions. In this manner, the test piece of ADAMS is moved so that the desired test points are moved into the beam. As discussed above, this movement of the test piece is what the instant invention seeks to avoid, since such movement can adversely affect the soldering joints by loosening or breaking them.

Therefore, Applicants submit that, in contrast to the feature of instant invention, ADAMS fails to disclose a test piece that is *fixed in a stationary position throughout the inspection*, and fails to disclose an X-ray beam tube and detector that are *linearly moveably*

arranged within parallel X-Y planes for inspecting an entire area of the at least one test object, as recited in at least independent claim 14. Further, Applicants note that ADAMS likewise fails to disclose *fixedly mounting* the at least one test object *in a stationary position throughout the inspecting of an entire area of the at least one object, linearly moving the X-ray beam tube and the detector* within parallel X-Y planes, to inspect the entire area of the at least one test object, as recited in at least independent claim 32.

While acknowledging that ADAMS fails to disclose linearly moving the X-ray beam tube and detector, the Examiner fails to show any teaching of fixing the test pieces in a stationary position throughout inspection, and fails to assert that NIKLASON teaches such a feature. Because neither applied document teaches or suggests at least the above-noted feature, Applicants submit that no proper combination of ADAMS and NIKLASON can render unpatentable the instant invention, as recited in at least the independent claims.

Further, while the Examiner asserts that NIKLASON shows an X-ray beam tube and detector that moves linearly within parallel X-Y planes, and that it would have been obvious to modify ADAMS to utilize such linear movement, Applicants traverse the Examiner's assertions.

In this regard, Applicants note that NIKLASON is directed to a pivoting detector, which moves in only a single plane, and that the art of record fails to provide any teaching or rationale for modifying NIKLASON for use with an X-ray tube *rotating* around a test

point, as disclosed by ADAMS. Further, Applicants note that, as neither document provides any teaching or suggestion to one ordinarily skilled in the art how to modify the structure and/or arrangement of elements of ADAMS in order to move linearly, as taught by NIKLASON, the asserted combination of documents is improper and should be withdrawn.

Further, Applicants submit that claims 15 - 24 and 27 - 31, and 33 - 37 are allowable at least for the reason that these claims depend from allowable base claims and because these claims recite additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of NIKLASON teaches or suggests, *inter alia*, a carrier adapted to be fixedly mounted throughout the inspection of the at least one test object, wherein said carrier is coupled to the at least one test object during the inspection, as recited in claim 15; a computing device being coupled to said detector, as recited in claim 16; an analysis unit being connected to said computing device, as recited in claim 17; said X-ray beam tube comprises a microfocus tube with a focal spot diameter of 10 to 40 μm , as recited in claim 18; said detector comprises a CCD chip arranged on a taper, as recited in claim 19; said X-ray beam tube and said detector are adapted for two-dimensional inspection of the test object, as recited in claim 20; said X-ray beam tube and said detector are adapted for three-dimensional inspection of the at least one test object, as recited in claim 21; the at least one test object comprises at least one of a printed circuit board and a loaded printed board assembly, as recited in claim 22; said device is adapted for

X-ray inspection of soldered joints on at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 23; said device is adapted for fully automated 100% X-ray inspection of soldered joints on at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 24; said X-ray beam tube and said detector are adapted to move parallel to each other, as recited in claim 27; said X-ray beam tube and said detector are adapted to move together in a same direction, as recited in claim 28; said X-ray beam tube and said detector are adapted to move in a same direction, as recited in claim 29; said X-ray beam tube and said detector are adapted to move in opposite directions, as recited in claim 30; said X-ray beam tube and said detector are adapted to move parallel to the at least one test object, as recited in claim 31; linearly moving the X-ray beam tube and the detector parallel to each other, as recited in claim 33; linearly moving the X-ray beam tube and the detector together in a same direction, as recited in claim 34; linearly moving the X-ray beam tube and the detector a same direction, as recited in claim 35; linearly moving the X-ray beam tube and the detector in opposite directions, as recited in claim 36; and linearly moving the X-ray beam tube and the detector parallel to the at least one test object, as recited in claim 37.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 14 - 24 and 27 - 37 under 35 U.S.C. §103(a) and indicate that these claims are allowable.

2. Over Adams in view of Niklason and Annis and further in view of Armistead

Applicants traverse the rejection of claim 25 under 35 U.S.C. § 103(a) as being unpatentable over ADAMS in view of NIKLASON and further in view of ANNIS and further in view of ARMISTEAD (U.S. Patent No. 4,852,131). The Examiner asserts that ARMISTEAD shows the use of learned characteristic vectors, and that it would have been obvious to modify the combination of ADAMS, NIKLASON, and ANNIS to include such a feature. Applicants traverse the Examiner's assertions.

Applicants note that, as ANNIS is not prior art against the instant invention, the asserted rejection is improper and must be withdrawn.

Further, Applicants note that, like ADAMS and NIKLASON, ARMISTEAD fails to disclose or suggest positionally fixing the test piece throughout testing, as recited in at least the independent claims. That is, Applicants note that ARMISTEAD discloses a scanning beam through which a test piece is moved and the beam source and detector are fixedly mounted. Accordingly, as none of the applied art teaches or suggests the above-noted feature of the instant invention, Applicants submit that no proper combination of the applied art can render unpatentable the instant invention.

Further, Applicants submit that ARMISTEAD fails to teach or suggest to one ordinarily skilled in the art the necessary motivation or rationale for modifying ADAMS to include linear movement, as taught by NIKLASON. Thus, Applicants submit that the only

reasonable rationale for modifying ADAMS in the manner asserted by the Examiner is the application of improper hindsight after reviewing Applicants' invention, which renders the rejection improper.

Moreover, ARMISTEAD fails to identify the problem addressed by the instant invention, i.e., loosening and/or breaking soldering joints due to the moving of the test piece throughout the inspection process, the applied art of record cannot even arguably suggest a solution to this problem. Therefore, Applicants submit that the applied art likewise fails to render the instant invention obvious.

Further, Applicants submit that claim 25 is allowable at least for the reason that it depends from an allowable base claim and because it recites additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of NIKLASON and ARMISTEAD teaches or suggests, *inter alia*, an analysis unit coupled to said detector, said analysis unit including a learning mode, so that, in said learning mode, a set of testing algorithms is transmitted to the analysis unit, and the algorithms are used to generate a characteristic vector for an individual soldered joint that is optimized to statistically represent a defect-free soldered joint, such that the characteristic vector is optimized by analyzing vectors of a same soldered joint on other at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 25.

Accordingly, Applicants request that the Examiner reconsider and withdraw the

rejection of claim 25 under 35 U.S.C. §103(a) and indicate that this claim is allowable.

3. Over Adams in view of Niklason, Annis, and Armistead and further in view of Rooks

Applicants traverse the rejection of claim 26 under 35 U.S.C. § 103(a) as being unpatentable over ADAMS in view of NIKLASON and further in view of ANNIS and further in view of ARMISTEAD and ROOKS (U.S. Patent No. 5,719,952). The Examiner asserts that ROOKS shows the use of a frame or pad image buffer, and that it would have been obvious to modify ADAMS and ARMISTEAD to include such a feature. Applicants traverse the Examiner's assertions.

Applicants again note that, as ANNIS is not prior art against the instant invention, the asserted rejection is improper and must be withdrawn.

Applicants note that, in contrast to the instant invention, ROOKS discloses a fixedly positioned rotating beam source and a fixedly positioned rotating detector in which a test piece is moved through a focal plane between these fixed rotating elements. Thus, Applicants submit that ROOKS fails to teach or suggest the subject matter noted above as deficient in the asserted combination of ADAMS, NIKLASON, and ARMISTEAD, such that no proper combination of the applied documents can render the instant invention unpatentable.

Further, Applicants note that as none of the applied documents of record identify the problem that Applicants have solved by the instant invention, the applied art of record cannot

even arguably suggest Applicants solution or render the instant invention obvious.

Further, Applicants submit that claim 26 is allowable at least for the reason that it depends from an allowable base claim and because it recites additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of NIKLASON, ARMISTEAD, and ROOKS teaches or suggests, *inter alia*, said analysis unit further including a testing mode, such that, in said testing mode, a pad image buffer, the set of testing algorithms, and the learned characteristic vectors with tolerances are transmitted to said analysis unit, and, in order to test a soldered joint, a correlation between the learned characteristic vectors with tolerances and the soldered joint under test is determined, as recited in claim 26.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claim 26 under 35 U.S.C. §103(a) and indicate that this claim is allowable.

Application is Allowable

Thus, Applicants respectfully submit that each and every pending claim of the present invention meets the requirements for patentability under 35 U.S.C. §§ 102 and 103, and respectfully request the Examiner to indicate allowance of each and every pending claim of the present invention.

Authorization to Charge Deposit Account

If for any reason a check including the amount for any necessary fees is not associated

with this file, the undersigned authorizes the charging of the amounts identified herein for the missing check, as well as any necessary fees not explicitly identified, including any extensions of time fees required to place the application in condition for allowance by Examiner's Amendment, to Deposit Account No. 19 - 0089 in order to maintain pendency of this application.

CONCLUSION

In view of the foregoing, it is submitted that none of the references of record, either taken alone or in any proper combination thereof, anticipate or render obvious the Applicants' invention, as recited in each of claims 14 - 37. The applied references of record have been discussed and distinguished, while significant claimed features of the present invention have been pointed out.

Accordingly, reconsideration of the outstanding Office Action and allowance of the present application and all the claims therein are respectfully requested and now believed to be appropriate.

Respectfully submitted,
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